VI. *A Remark upon the New Opinion relating to the Forces of moving Bodies, in the case of the Collision of* Non-Elastic Bodies. *By Mr.* John Eames, *F. R. S.*

1. THE antient Opinion, and moſt generally enter-
tained, is, that the Forces of Bodies in Motion
are as their Quantities of Motion, *i. e.* as their Quanti-
ties of Matter multiplied by their reſpective Celeri-
ties.

2. The new Opinion is, that the Forces of Bodies in
Motion are as their Quantities of Matter multiplied by
the Squares of the Velocities ; ſo that in equal Maſ-
ſes the moving Forces will not be as the Velocities
themſelves, but as their Squares.

3. Hence it follows, that a Body moving with five
Degrees of Velocity, moves with five and twenty Times
more Force, than when it moves but with one Degree ;
whereas according to the common Opinion, it has but
five times as much, *i. e.* proportional to its Velocity.

4. The lateſt Experiments brought to prove the
truth of the new Opinion are made upon ſoft, or
yielding Subſtances. Now theſe have been alrea-
dy obſerved to be a little complicated, and improper
for this Purpoſe. The proper Uſe of Experiments of
this kind being rather to diſcover, and ſettle the Laws,
which ſuch kind of Subſtances obſerve in the Reſiſtance
they make to Bodies moving in them, than the Forces
themſelves, with which the Bodies move, which ought
to be determined before hand by ſome ſimple Experi-
ment, fit to determine that Matter.

5. A

5. A variety of Experiments have been made, and reafoning ufed in *Ergland* and *France*, to prove the Truth of the common Opinion; but they do not entirely fatisfie all the Gentlemen on the other fide of the Queftion. The prefent ingenious Profeffor of Mathematicks and Philofophy at *Utrecht* tells us in the Preface to his *Epitome Elementorum Phyfico-Mathematicorum*, publifh'd this Year, *Anno* 1726, *In corporum motorum viribus fupputandis amplexus fum fententiam Cl.* Leibnitfii, Hugenii, Poleni, S. Gravefandii, *& antiquæ valedixi, quam hactenus foveram, & docueram : Neque me retinuerunt argumenta doctiffimorum virorum in* Galliis *& Britannia eandem defendentium.*

Et quando experimenta à Poleno *&* 'S Gravefandio *defcripta examinantur & infpiciuntur, tam manifefto evincunt vires corporum percutientium effe in ratione compofita ex quadrata velocitatum, & fimplici maffarum, ut illis fubfcribere teneamur, nifi apertiffimis contradicere ftudeamus.*

6. I beg leave to examine the truth of the new Opinion in the Cafe here propofed, *viz. Vires corporum percutientium*; and I fhall endeavour to fhew from their own Principles, that it cannot be true in all the Cafes of Non Elaftic Bodies.

7. 'Tis allow'd, that the common Rules of finding the Velocities of Non-Elaftic Bodies after the Stroke are true : For thus the ingenious Mr. *S. Gravefand* tells us in Paragraph 251, of his *Supplementum Phyficum* ; *Ex hoc principio* (i. e. *multiplicando maffam per velocitatem) deduxêre Philofophi ipfas illas regulas* n. 234. f. 237. f. *quas nos variis modis ex principiis noftris deduximus ; mirum hîc quid contigit, error erroris fuit deftructio, & duplex error ad veritatem conduxit; falfum de menfura virium fecuti funt principium, & quod veritati etiam minimè congruum eft, nullam vim intro premendo*

partes

partes, & harum superando cohæsionem corpora amittere po-
suere.

8. Now the Rule for finding the common Velocity
of Non-Elaftic Bodies moving the fame way after the
Collifion, is, to divide the Sum of the Quantities of
Motion in the two Bodies, by the Sum of the Quan-
tity of Matter.

9. 'Tis alfo granted, *Motu duobus corporibus commu-*
ni corpora hæc in fe mutuo agere non poffe. In Sect. 215.
Supplement. Phyf.

10. *Pendet ergo ictus à velocitate refpectiva, qua ma-*
nente intenfitas impactionis eadem erit, quomodocunque
celeritates abfolutæ varient.

11. *Ab intenfitate hac pendet partium introceffio, quæ*
ergo femper eadem erit, fi duo corpora eadem velocitate
refpectiva in fe mutuo incurrunt, quibufcunque velocitati-
bus moveantur.

12. Thefe Principles furnifh us with an Argument
againft the new Opinion. For if it be true, then e-
qual Caufes may have unequal Effects, and that in
their own fenfe of an Effect : The Proof fhall be ta-
ken from Inftances of the Effects of the Collifion of
Non-Elaftic Bodies, whofe refpective Velocities fhall
be always equal.

13. Let (A) and (B) ftand for two Non-Elaftic
Bodies of equal Quantities of Matter ; and let (B) be
at reft, while (A) moves towards it with 8 degrees of
Velocity.

1. Here the common Velocity after the Stroke
will be half the Velocity of (A) before the Stroke,
i e. 4 degrees. Confequently the force in (B) thus
communicated by the Stroke will be as its Square,
or 16.

2. Let

2. Let (B) move forward with two degrees of Velocity, and (A) follow it with 10 degrees; the refpective Velocity will be 8 as before; confequently by Paragraph 10th of this Paper, the Strokes in both cafes are equal. The Velocity in (B) after the Stroke will be half the Sum of the Velocities before the Stroke, or 6 degrees, by Paragraph 8th.

According to the new Opinion, the Forces being as the Squares of the Velocities, the Force of (B) before the Stroke will be to its Force after the Stroke, as the Square of 2 is to the Square of 6; *i e.* as 4 is to 36. Subduct the Force in (B) before the Strcke, from the Force it has after the Stroke, and you have the Degrees of Force communicated by the Stroke : Which, if this Opinion were true, would be 32, *i. e* juft double the Number of Degrees communicated by the fame Force in the former Inftance, which was but as 16. Thus equal Strokes produce unequal Effects in our fenfe of Effects.

14. The following Table gives feveral other Inftances. In the three firft Columns you have the Velocities of the two Bodies both before, and after the Stroke; in the two next, you have the Forces in (B) both before, and after the Stroke; and in the fixth, the Difference of thofe Forces, or the different Degrees of Force effected by the fame Stroke; and in the laft Column, the Proportion of thofe Forces, or Effects of the Caufe or Stroke.

The

The Velocity in			The Forces in B.		Force communicated by the Stroke.	Proportion.
A	B	B				
8	0	4	0	16	16	1
10	2	6	4	36	32	2
14	6	10	36	100	64	4
18	10	14	100	196	96	6
22	14	18	196	324	128	8
26	18	22	324	484	160	10
Before		After	Before	After		
the Stroke.			the Stroke.			

15. If it be faid, that I have not confider'd the other part of the entire Effect of the Stroke, the Intropreffion of the Parts ; I reply, this will make but a fmall Alteration in the matter ; fince the Intropreffions in all thefe Cafes are equal, (Paragr 11.) the relative Velocities being by fuppofition the fame: So that notwithftanding upon the whole, one and the fame, or equal Caufes, will produce unequal Effects.